Electronics Base Level Observation : Surprising Behaviour Of the Resistance Of 2 Digit Value

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Abstract

Experiment with a **Resistance** of 2 - digit value and observing its strange behavior.

Resistance : The ratio of the **Voltage** applied to the **Current** flowing through it. Let the **Voltage** applied to the conductor is (*V)* and **Current** (*i)* then the **Resistance** (*R*) of the conductor is,

$$R = V/I$$

And the device specifically made for providing resistance to the circuit is called **Resistor**

Fig. 1. A real resistor

Fig. 2. Figure of a resistor

Combination Of Resistance

Combination Of Resistance In Series

A combination of two or more resistors are said to be in a series when the **voltage** across each resistor is the same.

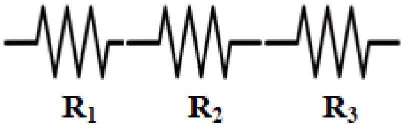

Fig. 3. Series Combination

The **Total** or **Equivalent** resistance ($\mathbf{R_s}$) is given by ;

$$\mathbf{R_s = R_1 + R_2 + R_3} \qquad \text{(For Fig. 3)}$$

For **'n'** number of electrons ($\mathbf{R_n}$) ;

$$\mathbf{R_s = R_1 + R_2 + R_3 + \ldots\ldots\ldots R_n}$$

Combination Of Resistance In Parallel

A combination of two or more resistors are said to be in a series when the **Current** across each resistor is the same.

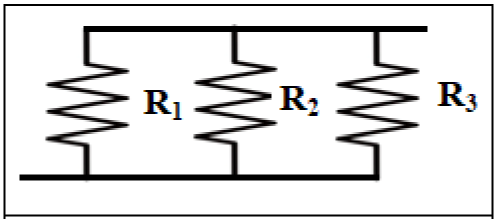

Fig. 4. Parallel Combination

The **Total** or **Equivalent** resistance ($\mathbf{R_p}$) is given by ;

$$\mathbf{1/R_p = 1/R_1 + 1/R_2 + 1/R_3} \qquad \text{(For Fig. 4)}$$

For **'n'** number of electrons ($\mathbf{R_n}$) ;

$$\mathbf{1/R_p = 1/R_1 + 1/R_2 + 1/R_3 + \ldots\ldots\ldots 1/R_n}$$

Observation

If we connect any **2 Digit Value** resistor in **parallel** with a **100 kΩ** resistor the **equivalent resistance** comes out to be approximately equal to the value of given resistor with the error of just **0.05 %**.

Let us take two resistors, $\mathbf{R_1 = 46\ \Omega}$ and $\mathbf{R_2 = 100\ k\Omega}$, then connect them in parallel now calculate the equivalent resistance $\mathbf{R_p}$ **;**

$$1/R_p = 1/R_1 + 1/R_2$$

$$1/R_p = 1/46 + 1/100000$$

$$1/R_p = 0.2175$$

$$R_p = 45.979\ \Omega \approx 46\ \Omega$$

Hence, we observed that $\mathbf{R_p} \approx \mathbf{R_1}$ (given 2 Digit Value resistor)

NOTE

$\mathbf{R_2 = 100\ k\Omega}$ will always be constant and wouldn't work with any other value of resistor.

Let's take some more examples ;

1. $\mathbf{R_1 = 32\ \Omega}$ and $\mathbf{R_2 = 100\ k\Omega}$ then $\mathbf{R_p = 31.989\ \Omega \approx 32\ \Omega}$.
2. $\mathbf{R_1 = 87\ \Omega}$ and $\mathbf{R_2 = 100\ k\Omega}$ then $\mathbf{R_p = 86.924\ \Omega \approx 87\ \Omega}$.
3. $\mathbf{R_1 = 65\ \Omega}$ and $\mathbf{R_2 = 100\ k\Omega}$ then $\mathbf{R_p = 64.958\ \Omega \approx 65\ \Omega}$.
4. $\mathbf{R_1 = 18\ \Omega}$ and $\mathbf{R_2 = 100\ k\Omega}$ then $\mathbf{R_p = 17.997\ \Omega \approx 18\ \Omega}$.
5. $\mathbf{R_1 = 76\ \Omega}$ and $\mathbf{R_2 = 100\ k\Omega}$ then $\mathbf{R_p = 75.942\ \Omega \approx 76\ \Omega}$.

Check out this python code for the above observation

Click Here To Execute The Code
